Ye Poor Man's EAS: TEXT, 2/26/2020

Comments about Part #15 AM, license-free, permissible Broadcasting operations have come into question since these permissibly, non-licensed, stations do not require the use of an Emergency Alert System, (EAS), that licensed broadcasters do. There are some serious Part #15 broadcasters that have actually gone through the acquiring and expense of obtaining an EAS, but when you consider that such a system, even used, can be over $2,000.00 working, it doesn't make financial sense, since many Part #15 stations themselves are not worth that. One neat tool that we have at our disposal is the use of cheap auto alerting NOAA Weather Radios. Alerts on the 162MHz NOAA Weather stations include more than just Weather Alerts, like Ambre Alerts, the new Silver Alerts, Local and National Emergencies, etc. It might be questioned today, “Well, what's the point with such alerts coming over on cell phones?”. The answer to that continues to be that 162MHz Weather Radio Service, and our own Part #15 stations, may cover in areas where cell service still does not penetrate. (Case in point, where the author lives at.) The following make-shift EAS has been drawn up and constructed to work at the location of the author's, thus some of the circuitry of what the author has added may not have to apply to your particular set-up.

The minimal bare bones Automatic Weather Alert Radio that was selected for price and performance is the Midland #WR120 for around $35.00 USD. And, what you get for that price is a little white box that contains both updated software and hardware to handle NOAA Radio Alerts at the time of this writing. One feature that has caught attention is the radio's EXTERNAL ALERT port. The one necessary modification that had to be done on the Weather Radio is an addition of an audio tapping jack to receive audio from the radio, since it does not include an earphone, or an External Speaker jack. The other modification is just the power power supply change that comes with the radio. The Midland #WR120 comes with a 9VDC – 300mA switching power supply that causes a lot of RF hash and noise well into the 162MHz VHF High Band. Therefore, it is suggested that this power supply be changed to a tranformered wallwart with the same voltage and current output ratings. These could be obtained for around $1.00 at many junk stores and flea-markets. Additional power supply ripple filtering can be

added, but the radio itself does contain an SMT LM7805, +5VDC, voltage regulator.

The Midland #WR120 Weather Radio manual can be download from https://midlandusa.com/support/owner-manuals/ Yes, you could buy direct from Midland USA the radio itself for $40.00, but you can save a few dollars by shopping from other sites on a web search. The author happened to use Amazon.com in this case.

The circuit of 'Ye Poor Man's EAS' takes advantage of the Midland #WR120 radio's features as well as work around the radio's idiosyncrasies as well as provide as an alternative for a non-noisy power supply requirements for both the EAS switching circuit and the radio. What it does is automatically switch over your station's main audio chain to a Weather Alert Radio's audio alert message, then mute the radio, and switch back to your station's main audio programing, and all automatically. And, thus far the expenses have been around $50.00 USD's, since the author had most of the parts and components already on-hand. Yeah, that's neat, and the price is right! Before hand, the author just manually switch audio to a scanner radio tuned to a local NOAA Weather Station, then manually back. The couple of advantages that a scanner radio had over the cheap 162MHz Weather 'only' Radio is the scanner's ability to automatically scan to another NOAA Weather Radio Station when the local primary station would go off-air for whatever reason. (That seems to happen a lot at the author's locations.) The other advantage that a scanner has is that it is a better grade of receiver and has better sensitivity for picking up weak VHF Band stations. However, having the advantage of a system that can automatically switch over alerts and air them, and then back to normal programing, is a nice advantage indeed.

What caught my attention to the Midland #WR120 Weather Radio is the feature of the EXTERNAL ALERT 1/8” port jack. This feature is suppose to activate the the LED red flasher accessory the Midland #18-STR Strobe Light. What was not clear was how the radio activates this feature. One would suspect that the radio itself would put out positive DC pulses to power the LED flasher, but that's not what happens here. It wasn't until a Youtube video on this weather radio and the strobe LED light flasher accessory revealed that the LED strobe flasher accessory is actually powered by AAA batteries, and the Weather Radio's EXTERNAL ALERT port jack just switches the Midland #18-STR Strobe Light on by closing a circuit to

near chassis ground. And one can test this with an Ohmmeter to the radio's EXTERNAL ALERT jack. It will measure less than 10 Ohms while doing a manual self ALERT TEST. Knowing this, one can now take advantage of this feature and use it as a trigger to do automatic relay switching of studio audio programing, using a circuit that utilizes RC Time Constance to a transistorized relay circuit. One physical modification that was done to the Weather Radio itself was the installation of a 1/8” audio speaker jack, that cuts to audio to the built-in speaker when a jack is inserted. Keep in mind, if you do this to a brand new Weather Radio, you will void the warranty. However, since it is a necessary modification to do , the author did this anyway. And surprise... Speaker ground is not chassis ground. There is a floating +2VDC potential on the speaker terminals with respect to the Weather Radio's chassis ground. That is addressed with DC blocking capacitors later. I've also noticed that the radio's built-in oval speaker is a 16 Ohm impedance, instead of the common 4, or 8, Ohm impedances. That is addresses later as well.

The Midland #WR120 Weather Radio's Manual describes how to do a quick set-up of your Weather Radio for you particular area. However, to utilize the features that are desired for 'Ye Poor Man's EAS' to function, the author has set-up the ten MENU's as follows:

SET TIME = (Your time.)

SET ALARM = OFF (This is the Alarm Clock feature, not needed.)

SET LANGUAGE = (Your preference, but it will be English for most.)

SET LOCATION = ANY

ALERT TYPE = VOICE

ALERT TEST = (Manually tests the alert function when you hit SELECT.)

SET CHANNEL = (Your local 162MHz NOAA Weather Radio Station.)

BACKLIGHT = ON / OFF / NORMAL (Backlight for screen setting. Your pick here.)
BUTTON BEEPS = ON / OFF (Your pick here. Beeps will be heard in

audio.)
SET EVENTS = ALL ON

The preceding MENU settings are all suggested settings, but are what work for the author. The Weather Radio works as follows when an alert triggers it. The EXTERNAL ALERT feature goes to a near chassis ground potential and there's an audio siren blare for 8 seconds, followed by the NOAA Weather Station message, then automatic mute when message is over. It is this 8 second of the weather radio's EXTERNAL ALERT that the following circuit takes advantage of for automatic audio program switching.

Referring to 'Ye Poor Man's EAS' two page diagram, the circuit board is a 2” X 3” Perf Board, with on side copper point plated, that I had already on hand. (A 'Parts List' of most of the components is later on.) This board was then divided into two opposite voltage supply rails, one for the POSITIVE and the other one for the GROUND, or what could be also considered Negative. It is best to label the rail, as what was done in the diagram with POSITIVE labeled as +12VDC and GROUND as GND. As mentioned before, it was suggested that the Midland #WR120 Weather Radio's included 9VDC – 300mA switch wallwart not be used, due to the incredible amount of noise and RF hash that it puts out, even at the 162MHz weather frequencies. A transformered AC to DC wallwart was obtained very cheaply at a junk store. You can certainly go with a current rating of well above 300mA, but it is not suggested to find one that is below that current rating. Unloaded, these wallwarts will measure around 12VDC, which suites our purpose just fine. This wallwart will power both the Weather Radio and the auto-switching audio relay circuits. Additional AC ripple filtering is obtained on the Perf Board with electrolytic capacitor, C1. (Be sure to observe capacitor's polarity.) As an option, a 12VDC Red LED, D6, was added as a means of a 'Power On' indication. This is of coarse your option to add, but does make for quick indication that the circuit is energized. Another added optional component is that of the double coiled toroid as a Radio Frequency Choke, RFC 1. Being that the author is an avid Amateur Radio Operator, this RFC, as well as the others added, is necessary to keep RFI, (Radio Frequency Interference.), out of the circuit. RFC2 is a optional clamp-on choke for further radio frequency suppression of RF in the DC power line, before it reaches the Weather Radio. Again, this is necessary for the author's location, but may not be necessary for yours.

The Alert / Audio Switchover works as follows. When the Weather Radio goes into an Alert, the EXTERNAL ALERT feature on the radio goes from an open to close a circuit to near the radio's chassis GROUND potential for 8 seconds. What goes into that jack is a 1/8” two conductor audio jack, the tip is what connects to a wire to the EAS switching circuit. The added RF suppression of choke, RFC3, may not be necessary for your application, but is for the author's. The 1k-Ohm resistor, R3, is to reduce any in-rush current to the Weather Radio, since this radio is mainly SMT (Surface Mount Tech.). This is then tied to the NEGATIVE side of electrolytic capacitor, C4. When the Weather Radio goes to ALERT mode, that EXTERNAL ALERT circuit closes to then discharge C4. This happens for 8 seconds, then C4 slowly builds up to +12VDC, of which, depending upon its value, varies the time that you want the ALERT AUDIO function for the audio relay to switchover and hold. 100uF will hold to about 4 seconds, (Way too short for this purpose.). 1,800uF will hold for about 60 seconds, (About right for many warnings and NOAA tests.). 2,200uF will hold to about 75 seconds, (Which should be sufficient for majority of warning alerts.). The author choose 2,200uF. This is then tied to the 10k-Ohm resistor, R1, and the Base of transistor, Q1, a 2N3906 PNP type transistor. When the Base of Q1 goes below +12VDC, micro-amps of current flow at the Base of Q1 to control the current flow of Q1's Emitter and Collector. Resistor, R2, on Q1's Emitter is a bit more added current limiting at 1 Ohm – 1W rating. Q1's Collector is tied to the relay coil of K1, a 12VDC coiled DPDT, (Double Pole, Double Throw.), relay, which magnetizes the relay to switchover the relay contacts from N.C., (Normally Closed.), to N.O., (Normally Open.), thus switching over your station's audio to the audio of the Weather Radio. It has been suggested that diode, D1, a 1N4001 diode, be added to K1's coil in reverse polarity to reduce voltage spikes that can occur during relay contact switching. When that 8 second Alert stops and opens the circuit on the Weather Radio's EXTERNAL ALERT jack, C4 then slowly recharges to +12VDC. When it gets near that, Q1 stops conducting and so does the current flow through K1's relay coil, where K1's contacts then switch back over from N.O. to N.C., thus switching back over your stations normal audio programing. This can be manually made to switch the relay over with the addition of S1, a SPST, (Single Pole, Single Throw.), switch tied between the GND Rail of the Perf Board and the NEGATIVE side of C4. This is the

MANUAL OVERRIDE switch. To overcome the time delay of C4 charging, when the MANUAL OVERRIDE switch is switched back off, an added DELAY DEFEAT M-O-M PB, (Momentary Push Button.), can be pressed for a couple of seconds to quickly charge C4 back to +12VDC through in-rush limit resistor, R5, 100 Ohm – 1W. (WARNING: DO NOT HIT MANUAL OVERRIDE SWITCH AND PUSH BUTTON SIMULTANIOUSLY AS IT WILL BURN UP R5 AND SHORT OUT POWER SUPPLY!)

The switchable audio path, as seen in the two page diagram, is how the author has routed for a two channel, (L/R Stereo.), audio chain. During normal programing operation, Main Board Audio Source is routed to the N.C., (Normally Closed.), contacts of relay K1. In N.C. operation, K1 routes the audio to the COM, (Common.), contacts that are then tied to the audio end path, audio Limiter / AGC, Compressor, EQ, Transmitter, etc. In ALERT mode, relay K1 switches the contact over to the N.O., (Normally Open.), contacts to stop the output from your main source to that of the treated Weather Radio's audio. Referring back to the Midland #WR120 Weather Radio, the only real modification done was to include an External Speaker jack, (Since it did not come with that feature.), that shuts off the radio's internal speaker when a 1/8” two conductor audio plug is inserted. By the way, the speaker's GND, (Ground.), is not the Weather Radio's chassis GND, but a floating GND with a +2VDC measured between chassis GND and speaker GND. Audio-wise, when the Weather Radio first goes into ALERT mode, for 8 seconds there is a blaring two tone siren that is about 250mW in audio power. Through the radios built-in 16 Ohm oval speaker, this is about 1/3 as loud as most smoke detectors. After that, there is the radio's NOAA Weather Station voice alert for the duration of whatever the alert is between the initial three digital tone-outs, (Which sets the Weather Radio into ALERT mode.), and the 'End-of-Message' three digital tone-outs that puts the Weather Radio back into mute mode. The Radio Frequency Choke, RFC2, maybe optional for your situation and location. By the way, the audio cable shields are tied together, but to keep that Weather Radio's +2VDC floating DC voltage out of the rest of the audio chain, capacitors C2 and C3 are the DC blocks. Since the radio's oval speaker was noticed at a high 16 Ohm impedance rating, R4, a 10 Ohm – 1W resistor is added in line as more of a protection to the radio's SMT audio amplifier. To contend with the variances of the radio's siren blare then the more subtle voice audio, a bank of diodes,

D2 – D5, are then added to limit the voltage level to a suitable level that will not damage audio end components down the chain. The diode configuration shown limits audio levels to peak at 1.4Vp. Most audio components can easily handle this level than the several volts peak that the Weather Radio's siren blare normally puts out. Next, to the N.O. contacts of relay K1. Then, to the audio processing and transmitter. By the way, the author ended up turning the Weather Radio's Volume all the way up to get decent NOAA Station audio level. You will have to experiment and adjust and set the Volume of the radio to suite your needs.

With the preceding set-up as explained, the Perf Board built and the Weather Radio's MENU settings, automatic operation of 'Ye Poor Man's EAS' are as follows. The Weather Radio's main side ON / OFF switch is in the ON position and the radio is in MUTE mode. Normal audio programing is going over your station. Then, the three digital pulses come over your local NOAA Weather Station, activates the Weather Radio out of MUTE mode, and the EXTERNAL ALERT jack in the radio closes the circuit to the relay on the Perf Board. Relay, K1, kicks over automatically from your normal station's programing to the Weather Radio's two tone blaring siren for 8 seconds, then comes the NOAA Station's voice message of whatever that is, a weekly test, weather statement, advisory, or warning, Ambre Alert, the newer Silver Alert, utility outages, or some other Local and National emergency. Capacitor C4 is slowly charging, and depending on what value you have set that at, (1,800uF for about 60 seconds, or 2,200uF for about 75 seconds.), one of two things will happen here. Either C4 will charge to near +12VDC, in which case the relay circuit will switch K1 back to your normal audio programing, or a short massage will come from the NOAA Station, which will send three digital tones that MUTE the Weather Radio, and then you have a few seconds of dead-air, until capacitor C4 reaches the charge to kick over K1 back to normal programing. So, not the perfect automated EAS-like set-up, but for most of our purposes, very usable indeed.

Manual operation of 'Ye Poor Man's EAS' can be as follows. Let's say that you want to broadcast NOAA Weather info for just the weather forecast, or you need a quick programing alternative to get you by from a computer crash, Internet stream quitting, whatever. First, UNMUTE the Weather Radio by hitting that large WEATHER / SNOOZE button, then flick the switch, S1, ON to kick over relay K1 to the Weather Radio audio. Now your station is

airing NOAA Weather. When you want to switch back manually to your station's main normal programing, switch S1 to OFF, then hit M-O-M PB until you hear relay K1, and your normal programing, going over-the-air on your station, and then take your finger off of M-O-M PB. Go back to the Weather Radio and hit the large WEATHER / SNOOZE button to put radio back into MUTE. And, that's it.

Possible questions, comments, and even answers, that may come from examining 'Ye Poor Man's EAS'? One big question that the author gets is, “Why did you build this that way and not this way?” The answer to that is this was made from what parts were on-hand, and what was needed still with minimal purchase and complications. The author was told that a version of 'Ye Poor Man's EAS' has been done with a $100.00 Kenwood car stereo with a built-in EAS alerting system. That sounds neat, and no doubt it is, but this system can be purchased and assembled for around $50.00. All this is, is a working bare-bones platform and template of what could be done. Can many of YOU run away with even better ideas? I know that you can, since there are others that always do so. Nothing is set in stone here. Case in point, why wasn't this done on an Arduino platform, or even a Commercial Programmable Logic Controller, (PLC)? And, you most certainly could. The author is not digital and software savvy, but considered more analog savvy. For those that use the computer, with radio station automation software as their main platform, most likely that could be taken advantage of. Also, it wouldn't surprise me if someone could write a smartphone APP that could possibly do like an EAS function today. If YOU can do that, run with it! The author's Part #15 stations are computer aided, but not totally computer dependent. The 'Ye Poor Man's EAS' takes advantage of how the author runs his station. Therefore, build what works for yours. Could the relay be VOX, (Voice activated.)? I suppose it could. With all the RF that the author contends at his location, VOX Operation was not seen as viable. The author already has been asked, “Why choose the make and model of the Weather Radio for this 'Ye Poor Man's EAS' and not some other?”. I believe that this was addressed earlier, but the Midland #WR120 Weather Radio was chosen for it's features, circuitry, and definitely its price. For under $40.00, you get a PLL, (Phase Locked Loop.), radio that puts up to date hardwares and softwares together in a neat little package, that's fairly user friendly, that includes an external trigger circuit that suites the needs for this project at the

time of this writing. Could something else be used? Certainly, but research what the features are, what the limits are, and the ease for which it can be applied to this project. What can be done without in the two page 'Ye poor Man's EAS' diagram? The author, at the time of this writing, lives in the bottom of a river valley where radio reception of anything is difficult. Most station ops can get away with a Weather Radio's built-in telescopic whip antenna indoors to receive a local NOAA Weather Station. The author can not, therefore an external 162MHz antenna and a VHF TV preamplifier are necessary for the author's location. Like-wise, Radio Frequency Chokes, RFC 1, 2, and 3, may not be needed for your application, but is necessary for the author. Then there is, “Why doesn't the author of this 'Ye Poor man's EAS' go apply for a patent for this idea?”. The author has gone through patenting an Indoor TV Antenna, US Patent #6,342,862, but did not get anywhere in marketing this. Thus, that put the author about -$12,000.00 in the hole financially. The author does not want to, nor can, afford to do that again. Therefore, just as has been done with that patent, this is available as an Open Source for anyone to research, build, apply, modify, etc., for their own use. Case in point, even if YOU have no intention of applying this to a Part #15 radio station, or your local net-casting stream station, this could be added to the audio chain of your entertainment system to interrupt and alert you while watching a net-stream show, a DVD, or even while listening to your MP3 library. See??? Even the applications could be for more than just broadcasters with only limits that your imagination can conceive. However, with that, it should be also worth mentioning that the preceding 'Ye Poor Man's EAS' should be only applied to unlicensed applications, like Part #15 broadcasting.

Parts list; As used in 'Ye Poor Man's EAS' as seen in the two page diagram include:

- Midland #WR120(B), Weather Radio. https://www.amazon.com/ , https://midlandusa.com/product-category/weather/ , Walmart, other retail locations.

- 1/8” (3.5mm) Two Conductor Closed Circuit Audio Jack. Radio Shack #274-248, https://www.allelectronics.com/ #MMJ-S, other retail locations.

- 1/8” (3.5mm) Two Conductor Audio Plug. Radio Shack #274-286(7),

https://www.allelectronics.com/ #PMP, other retail locations.

- K1, 12VDC DPDT “DIP type” Relay. Radio Shack #257-0249, https://www.allelectronics.com/ #RLY-622, or equivalent.

- Q1, 2N3906 PNP Transistor. Radio Shack #276-2023, https://www.allelectronics.com/ #2N3906, or other electronic retail locations.

- D1-D5, 1N4001 Diodes. Radio Shack #276-1101, https://www.allelectronics.com/ #1N4001, or other electronic retail locations.

- (Optional), D6, 12VDC Red 5mm LED. https://www.allelectronics.com/ #LED-12R.

- Perf Board. Radio Shack #276-148, https://www.allelectronics.com/ #PC-3.

- S1, SPST Switch. Any type, from anywhere.

- M-O-M PB, Momentary Push button. Any type, from anywhere.

- (Optional.) RFC 1 and 3. Any power in-line Radio Frequency Chokes.

- (Optional.) RFC 2. Snap-On Radio Frequency Choke. Radio Shack #273-0067, https://www.allelectronics.com/ #FB-103.

- Resistors and Capacitors, (As seen in two page diagram for values and ratings.) . Radio Shack, MCM Electronics, Mouser Electronics, Digikey, or any other retail electronics outlet.

- AC / DC 9VDC – 300mA Transformered Wallwart. Used from many junk-type stores. Or new, https://www.allelectronics.com/ #DCTX-936.